TOWARD A BAYESIAN ANALYSIS OF RECANTED EYEWITNESS IDENTIFICATION TESTIMONY

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The reliability of eyewitness identification has been increasingly questioned in recent years. Despite acknowledgment that such evidence is not only unreliable, but also overly emphasized by judicial decisionmakers, in some cases, antiquated procedural rules and lack of guidance as to how to properly weigh identification evidence produce unsettling results. Troy Anthony Davis was executed in 2011 amidst public controversy regarding the eyewitness evidence against him. At trial, nine witnesses identified Davis as the perpetrator. However, after his conviction, seven of those witnesses recanted. Bogged down by procedural restrictions and long-held judicial mistrust of recantation evidence, Davis never received a new trial and his execution produced worldwide criticism.

On the 250th anniversary of Bayes' Theorem, this Note applies Bayesian analysis to Davis's case to demonstrate a potential solution to this uncertainty. By using probability theory and scientific evidence of eyewitness accuracy rates, it demonstrates how a judge might have included the weight of seven recanted identifications to determine the likelihood that the initial conviction was made in error. This Note demonstrates that two identifications and seven nonidentifications results in only a 31.5% likelihood of guilt, versus the 99% likelihood represented by nine identifications. This Note argues that Bayesian analysis can, and should, be used to evaluate such evidence. Use of an objective method of analysis can ameliorate cognitive biases and implicit mistrust of recantation evidence. Furthermore, most arguments against the use of Bayesian analysis in legal settings do not apply to post-conviction hearings evaluating recantation evidence. Therefore, habeas corpus judges faced with recanted eyewitness identifications ought to consider implementing this method.

Introduction

In the early hours of August 19, 1989, after a night of drinking and partying, Troy Anthony Davis, Sylvester "Redd" Coles, and another friend got into an altercation with a homeless man in a Burger King parking lot. Off-duty police officer Mark MacPhail, moonlighting as a security guard, responded to the disturbance. One of the men shot him dead. Witnesses reported varying accounts of the night, and Redd Coles eventually reported Davis to the police. At Davis's trial, nine witnesses identified Davis as the shooter. Davis was sentenced to death.[1] Later, however, seven of the nine witnesses recanted

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[1] *In re* Davis, No. CV409-130, 2010 WL 3385081, at *54 (S.D. Ga. Aug. 24, 2010) (discounting the importance of "recantations by seven of nine state witnesses"); *see also* Press Advisory, Department of Law, State of Georgia, New Execution Date Set for Troy Anthony Davis (Oct. 15, 2008), *available at* http://law.ga.gov/press-releases/2008-10-15/new-execution-date-set-troy-anthony-davis-who-was-convicted-1989-murder (discussing the facts and procedural history of *Davis*).

their testimony identifying Davis as the shooter, citing police coercion.[2] Moreover, two of the recanting witnesses now identified the shooter as Redd Coles. Only two witnesses remained against Davis; one of them was Coles himself.[3]

Nonetheless, despite numerous appeals, a habeas corpus hearing on the recanted eyewitness evidence, and even direct review by the Supreme Court, Davis was executed on September 21, 2011.[4] The seven recanting witnesses made the execution highly controversial.[5] The judge reviewing this new evidence concluded that it did not meet the standard for habeas corpus relief because recanted testimony is inherently unreliable and because two witnesses still remained who positively identified Davis.[6] The reviewing judge's evaluation of the recanted identifications typifies courts' treatment of recantation evidence.[7] Rather than consider all the evidence "as a whole" as directed by the Antiterrorism and Effective Death Penalty Act (AEDPA),[8] he dismissed the recantation testimony as untrustworthy.[9]

The legal system has long grappled with the problem of recanted identification testimony. There is an intuitive difference between a nonidentification arising from a recantation and a nonidentification in the first instance (*e.g.*, if a witness fails to select the suspect in a police lineup), but no guidance as to how to deal with this difference when a nonidentification (*i.e.*, the recantation of an earlier positive

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[2] *Davis*, 2010 WL 3385081, at *47–54 (discussing recanted and altered testimony by various state witnesses).

[3] *Id.* at *55–57 (stating that two witnesses now identify Coles as the shooter and five additional witnesses claim Coles confessed to the murder).

[4] *Troy Davis Put to Death in Georgia*, CNN.COM (Sept. 22, 2011, 2:14 AM), http://www.cnn.com/2011/09/21/justice/georgia-execution.

[5] *See, e.g.*, Petition for a Writ of Certiorari at 6, Davis v. Terry, 551 U.S. 1145 (2007) (No. 06-1407), 2007 WL 1211664, at *6 ("[A]ll of the State witnesses who testified against Petitioner—save Red [sic] Coles and an eyewitness who disappeared after trial—have recanted or contradicted their trial testimony."); John Rudolf, *Troy Davis Execution: Former FBI Chief William S. Sessions Calls on Georgia to Stay Order*, HUFFINGTON POST.COM (Sept. 15, 2011, 9:20 AM), http://www.huffingtonpost.com/2011/09/15/troy-davis-execution-william-sessions_n_963366.html (listing doubts regarding Davis's guilt and objections to his execution); *Troy Davis Executed for Killing Off-Duty Police Officer*, AUGUSTA CHRON. (Sept. 21, 2011, 9:21 AM), http://www.chronicle.augusta.com/latest-news/2011-09-21/troy-davis-executed-killing-duty-police-officer?v=1316678774 (discussing the *Davis* case and the public reaction to the execution).

[6] *Davis*, 2010 WL 3385081, at *61 n.108; *see* Press Advisory, *supra* note 1 (setting new execution window for Davis and outlining the history of his case).

[7] *See infra* Part I.B (discussing courts' treatment of recanted testimony).

[8] Antiterrorism and Effective Death Penalty Act of 1996 (AEDPA) § 106, 28 U.S.C. § 2244(b)(2)(B)(ii) (2006) ("[T]he facts underlying the claim, if proven and viewed *in light of the evidence as a whole*, would be sufficient to establish by clear and convincing evidence that, but for constitutional error, no reasonable factfinder would have found the applicant guilty of the underlying offense." (emphasis added)).

[9] *See Davis*, 2010 WL 3385081, at *61.

identification) occurs after conviction.[10] As a result, the pull to completely discount recantation evidence is strong. Most importantly, judicial actors are unsure how to interpret recanted evidence.[11] This Note, using the Troy Davis case as an example, provides an alternative to the dismissive manner in which most judges treat recanted eyewitness testimony. I argue that recantation evidence should be evaluated using Bayesian analysis. This analytical tool would allow a judge in a habeas hearing to systematically examine the impact of the changed positions of existing witnesses upon a defendant's likelihood of guilt. Bayesian analysis would ensure that a judge in a habeas hearing could better apply the standard for granting a new trial based on newly discovered evidence, giving proper weight to the recantation testimony.

While the use of Bayesian methods in the legal setting has been the subject of academic debate for several decades, I argue that habeas corpus hearings based on new testimony recanting eyewitness testimony are an appropriate place to employ Bayesian inference for two reasons. First, Bayesioskeptic arguments have less force when considered in the context of a post-conviction hearing, as opposed to, for example, jury deliberations in a criminal trial. Second, a systematic method of analyzing a recanted identification's effect on a defendant's likelihood of guilt can help courts to identify erroneously convicted defendants. This is especially important for eyewitness identifications, which are known to be inaccurate in the first instance, yet are given great weight by factfinders.[12]

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[10] The ongoing struggle to properly account for recantation evidence and the public reaction to *Davis* reflects this intuition. Kimberly Davis, Troy Davis's sister, describes the conflict well: "They insisted on executing an innocent man despite so much doubt around the case. If those seven witnesses were credible enough to put my brother on death row, then why weren't they credible when they recanted?" Ed Pilkington, *Troy Davis Execution, One Year On: 'We Want to Stop Killing Innocent Men,'* GUARDIAN (Sept. 21, 2012, 10:14 AM), http://www.guardian.co.uk/world/2012/sep/21/troy-davis-execution-one-year; *see also, e.g.*, Michael McDonnell Hill, *Seen but Not Heard: An Argument for Granting Evidentiary Hearings to Weigh the Credibility of Recanted Testimony*, 46 GA. L. REV. 213 (2011) (discussing courts' hostile view of recantation testimony and arguing, based on *Davis*, for greater use of evidentiary hearings to evaluate such evidence); Monica Moorehead, *World Outraged by Troy Davis Case*, WORKERS WORLD (Sept. 21, 2011, 5:43 PM), http://www.workers.org/2011/us/troy_davis_0929/ ("Millions of people in the U.S. and worldwide have been outraged by this horrendous decision. This outrage has been expressed by hundreds of protests . . . .").

[11] *See infra* Part I.B (discussing courts' inconsistent treatment of recantation evidence).

[12] *See generally* ELIZABETH F. LOFTUS, EYEWITNESS TESTIMONY 9 (2d ed. 1996) (reviewing the literature on eyewitness testimony and concluding that eyewitness identifications can be "overwhelmingly influential" in court). For a review of the social science literature as applied by the New Jersey Supreme Court in reforming its standards on the use of eyewitness identifications, see Stuart Rabner, *Evaluating Eyewitness Identification Evidence in the 21st Century*, 87 N.Y.U. L. REV. 1249, 1254–58 (2012). *See also* State v. Henderson, 27 A.3d 872 (N.J. 2011) (applying findings to new trial procedures). The

This Note proceeds as follows. It first discusses the current judicial treatment of recanted eyewitness identification evidence under the AEDPA. It then describes Bayesian inference and illustrates its applicability to recanted identifications by performing an analysis of Troy Davis's likelihood of guilt at trial as compared to post-conviction. Finally, it explains why Bayesioskeptic arguments do not foreclose application of Bayesian analysis in the context of post-conviction evaluation of recanted eyewitness identification testimony.

I

Traditional Judicial Treatment of Recanted Identification Testimony

Recanted testimony refers to a witness's intentional, public reversal of the testimony she gave at trial. In general, courts view recantation evidence with suspicion[13] and new trials based on recanted testimony are extremely rare.[14] Today, the federal standard for post-conviction hearings based on newly discovered evidence of innocence is set by the AEDPA.[15] In the following Part, I describe the AEDPA standard for evaluating newly discovered evidence, using the *Davis* case as an example. I then lay out the policy and cognitive bases for judicial skepticism of recanted evidence.

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likelihood of a witness accurately identifying a (known-guilty) suspect is approximately 45% under laboratory conditions. *See* Steven E. Clark et al., *Regularities in Eyewitness Identification*, 32 Law & Hum. Behav. 187, 192 tbl.2 (2008) (using meta-analysis to analyze a large number of eyewitness accuracy studies). Moreover, an eyewitness can be expected to identify an innocent look-alike approximately one-third of the time when the suspect is not in the lineup. *See id.*; Rabner, *supra*, at 1264 & n.106.

[13] *See, e.g.*, People v. Shilitano, 112 N.E. 733, 736 (N.Y. 1916) ("There is no form of proof so unreliable as recanting testimony."); *see also, e.g.*, United States v. Papajohn, 212 F.3d 1112, 1117 (8th Cir. 2000) ("Motions for a new trial based upon the alleged recantation of a material witness are viewed with disfavor in this circuit and are difficult to win."), *abrogated on other grounds by* Crawford v. Washington, 541 U.S. 36 (2005); United States v. Pearson, 203 F.3d 1243, 1275 (10th Cir. 2000) ("[R]ecanted testimony is properly viewed with suspicion." (quoting United States v. Ramsey, 726 F.2d 601, 605 (10th Cir. 1984))); United States v. Gallego, 191 F.3d 156, 166 (2d Cir. 1999) ("Courts are particularly reluctant to grant [motions for a new trial] where the newly discovered evidence consists of a witness recantation as such recantations are looked upon with the utmost suspicion." (citation and internal quotation marks omitted)), *abrogated on other grounds by Crawford*, 541 U.S. 36; Sharon A. Cobb, *Gary Dotson as Victim: The Legal Response to Recanting Testimony*, 35 Emory L.J. 969, 981 (1986) ("Courts are extremely distrustful of recantations.").

[14] *See* 3 Charles Alan Wright & Sarah N. Welling, Federal Practice and Procedure, Criminal § 585 (4th ed. 2011) ("The judicial attitude is that recantation should be looked on with the utmost suspicion. Only on very rare occasions will a court grant a new trial on this ground." (internal quotation marks omitted)); *see also* sources cited *supra* note 13.

[15] *See infra* note 17.

A. Newly Discovered Evidence Under the AEDPA

Recantations that occur after conviction are considered new evidence, so a defendant is barred from presenting such evidence on direct appeal.[16] This leaves a new trial motion as the only avenue to present recanted testimony to a court as evidence. However, a new trial based on newly discovered evidence is considered extraordinary relief. The standards for both new evidentiary hearings and new trials under the AEDPA are exacting.[17]

Troy Davis's initial attempt to raise the recantation evidence through a federal appeal was rejected by the Eleventh Circuit in 2006.[18] Prior to 1996, defendants were free to file multiple petitions for habeas corpus relief in federal court. So long as a new issue was raised, petitions were regularly granted.[19] Since the AEDPA's enactment, however, if a federal court denies habeas relief in the first petition, the prisoner must secure a certificate of appealability before filing a subsequent habeas petition with the district court.[20] Thus, the AEDPA prevented Davis from filing a subsequent writ of habeas corpus directly in federal court—the standard move pre-AEDPA. Instead, to allow the subsequent petition, Davis's certificate of appealability would first have to be approved by a panel of Eleventh Circuit judges.

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[16] *See generally* Rhett R. Dennerline, Note, *Pushing Aside the General Rule in Order to Raise New Issues on Appeal*, 64 IND. L.J. 985, 985 (1989) ("[C]ourts are constrained by their own (judicially created) general rule of practice which states that no new issues may be raised on appeal.").

[17] *See* AEDPA § 104, 28 U.S.C. § 2254 (2006) (requiring "clear and convincing evidence" to overrule findings of fact); Williams v. Taylor, 529 U.S. 362, 387 n.14 (2000) (describing the changes made to the availability of successive habeas petitions and of evidentiary hearings on habeas review). The standard for the "extraordinary relief" of granting a new trial is purposefully arduous. *See, e.g.*, Metso Minerals, Inc. v. Powerscreen Int'l Distrib. Ltd., 833 F. Supp. 2d 282, 294 (E.D.N.Y. 2011) ("The granting of a new trial is extraordinary relief."), *rev'd*, No. 2011-1572, 2013 WL 1969309 (Fed. Cir. May 14, 2013); Romero v. CSX Transp., Inc., No. CIV. A . 06-1783 SRC, 2010 WL 1372296, at *1 (D.N.J. Mar. 31, 2010) ("The standard for a movant to obtain a new trial . . . is a high one."); United States v. Camacho, 188 F. Supp. 2d 429, 436 (S.D.N.Y. 2002) (same); Pan Bldg., Inc. v. Phila. Hous. Auth., No. CIV. A. 87-3912, 1989 WL 73661, at *2 (E.D. Pa. June 29, 1989) ("Because motions for a new trial on the basis of newly-discovered evidence seek extraordinary relief, they will be granted only in exceptional circumstances, and then only when the requirements are strictly met.").

[18] The Eleventh Circuit rejected the appeal because Davis "d[id] not make a substantive claim of actual innocence." Davis v. Terry, 465 F.3d 1249, 1251 (11th Cir. 2006).

[19] The abuse-of-the-writ doctrine provided the means to deny successive habeas petitions. The burden was on the government to plead such abuse; if it did not, or if the defendant showed cause and prejudice, the petition was granted. McCleskey v. Zant, 499 U.S. 467, 494–95 (1991).

[20] FED. R. APP. P. 22(b) (describing certification requirements).

Certificates of appealability are rarely granted.[21] To be granted review of subsequent habeas petitions, the defendant must show new factual evidence that (1) could not have been discovered at trial, and (2) would be sufficient to show, by clear and convincing evidence, that no reasonable factfinder would have convicted the defendant but for the constitutional error.[22] Days before Davis's second scheduled execution date, the Eleventh Circuit panel decided that the recantation affidavits were unpersuasive, and thus that Davis had not met the high burden required for filing a subsequent habeas petition.[23] His only remaining option was to file an original writ directly with the United States Supreme Court.[24] Davis made a filing with the Court and, as a

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[21] *See* Eve Brensike Primus, *A Structural Vision of Habeas Corpus*, 98 Calif. L. Rev. 1, 2 (2010) ("[D]eferential standards of review all but ensure that the state conviction will stand. In the extremely rare case where a federal court grants relief, the judgment comes years after the petitioner was wrongly imprisoned."); *see also* Nancy J. King et al., Executive Summary: Habeas Litigation in U.S. District Courts: An Empirical Study of Habeas Corpus Cases Filed by State Prisoners Under the Antiterrorism and Effective Death Penalty Act of 1996, at 10 (2007), *available at* https://www.ncjrs.gov/pdffiles1/nij/grants/219558.pdf (reporting on "267 capital cases that were filed in 2000, 2001, and 2002 and terminated in district court before December 2006" and finding that only one in eight received any form of relief: "Of the 33 cases receiving relief: 23 involved relief from the death sentence alone, 14 were grants based on ineffective assistance of counsel, and 9 were grants based on ineligibility for the death penalty under [Supreme Court precedent].").

[22] *See* AEDPA § 106, 28 U.S.C. § 2244(b)(2)(B)(ii) (2006). The second prong, requiring constitutional error, could be problematic in a case like *Davis* because the discovery of the recanted identifications was not due to any claimed constitutional error. Theoretically, the execution of an innocent person may be constitutionally intolerable in satisfaction of AEDPA prong two. While the U.S. Supreme Court has not declared execution of an innocent person unconstitutional, in *Davis*, Judge Moore held that such executions were unconstitutional. *Compare In re* Davis, 130 S. Ct. 1, 3 (2009) (mem.) (Scalia, J., dissenting) ("This Court has *never* held that the Constitution forbids the execution of a convicted defendant who has had a full and fair trial but is later able to convince a habeas court that he is 'actually' innocent."), *with In re* Davis, No. CV409-130, 2010 WL 3385081, at *61 (S.D. Ga. Aug. 24, 2010) (holding that "executing an innocent person would violate the Eighth Amendment of the United States Constitution" but finding that Davis failed to show his innocence). While the Supreme Court itself has never said that execution of an innocent person would be unconstitutional, at least one Justice has suggested as much. *See* Herrera v. Collins, 506 U.S. 390, 419 (1993) (O'Connor, J., concurring) ("[T]he execution of a legally and factually innocent person would be a constitutionally intolerable event."); *McClesky*, 499 U.S. at 495 (including "fundamental miscarriage of justice" exception to the prejudice requirement for abuse-of-the-writ to avoid unconstitutional loss of liberty to innocent persons).

[23] *In re* Davis, 565 F.3d 810, 826 (11th Cir. 2009). A vague reference to the majority being "unpersuaded" by the recantation testimony exemplifies the dysfunctional way in which judges currently view recantation evidence. *Id.* at 825 ("We thus approach the recantation affidavits with some skepticism, as we must, and, reviewing the record as a whole, remain unpersuaded.").

[24] The circuit court decision effectively foreclosed further relief under the AEDPA. Davis had exhausted his statutory state and federal appeals, leaving the Supreme Court as his final avenue of respite. *See Davis*, 565 F.3d at 827 (denying leave to file successive writ,

result, the Court directed Judge Moore of the Southern District of Georgia to "receive testimony and make findings of fact as to whether evidence that could not have been obtained at the time of trial clearly establishes [Davis's] innocence."[25] The "[c]learly establishes" standard apparently was meant to instruct the judge to apply the AEDPA's requirement for "clear and convincing evidence"[26] to newly discovered evidence.[27] If the newly discovered evidence surpassed a threshold of "clear and convincing evidence" of innocence, Davis would be granted a writ of habeas corpus. Following these instructions, Judge Moore determined that the recanted eyewitness identifications—and new witnesses' testimony implicating Coles as the actual shooter—were not credible. He found that "while the State's case may not be ironclad, most reasonable jurors would again vote to convict Mr. Davis of Officer MacPhail's murder."[28] Davis appealed, but the Eleventh Circuit rejected his appeal without ruling on the merits.[29] The Supreme Court rejected Davis's petition for review of Judge Moore's decision without comment.[30]

Judge Moore treated the recanted testimony with the same uncertainty most courts exhibit when presented with this type of evidence. While Judge Moore briefly evaluated the credibility of each withdrawn identification,[31] he did not explicitly describe what the effect of the recantations would be "if proven, in light of the evidence as a whole" on the "clear and convincing evidence" determination prescribed by the AEDPA.[32] Instead, he concluded only that "most reasonable jurors would again vote to convict," without directly explaining whether that conclusion meant that the AEDPA's "clear and convincing" standard had not been met, or how the conclusion fit

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but staying execution for thirty days "because Davis still may file a habeas corpus petition in the Supreme Court, pursuant to its original jurisdiction"); *see also* SUP. CT. R. 20.4(a) ("To justify the granting of a writ of habeas corpus, the petitioner must show that exceptional circumstances warrant the exercise of the Court's discretionary powers, and that adequate relief cannot be obtained in any other form or from any other court. This writ is rarely granted.").

[25] *Davis*, 130 S. Ct. at 1.

[26] AEDPA § 106, 28 U.S.C. § 2244(b)(2)(B)(ii) (2006).

[27] *See* Joshua M. Lott, *The End of Innocence? Federal Habeas Corpus Law After* In re Davis, 27 GA. ST. U. L. REV. 443, 467–68 (2011) (discussing Judge Moore's interpretation of the Supreme Court's "four-sentence decision" as requiring AEDPA's "clear and convincing" standard of proof for Davis's innocence).

[28] *In re* Davis, No. CV409-130, 2010 WL 3385081, at *61 n.108 (S.D. Ga. Aug. 24, 2010).

[29] Davis v. Terry, 625 F.3d 716, 719 (11th Cir. 2010) (concluding that Davis's recourse lay with the United States Supreme Court rather than the circuit court).

[30] Davis v. Humphrey, 131 S. Ct. 1787 (2011) (denying certiorari).

[31] *See Davis*, 2010 WL 3385081, at *60 (finding each piece of Davis's recantation evidence suspicious or otherwise incredible).

[32] *See* AEDPA § 106, 28 U.S.C. § 2244(b)(2)(B)(ii) (2006).

into the standard more generally.[33] As discussed in the next section, Judge Moore's opinion is a typical example of the way courts deal with recanted identification evidence.

B. Judicial Skepticism Toward Recanted Testimony

Judges require extraordinary evidence that testimony presented at trial was false before a new trial will be granted, and tend to dismiss recanted eyewitness identifications out-of-hand[34]—despite evidence that eyewitness evidence is unreliable and frequently results in wrongful convictions.[35] The requirements for a new trial are so stringent that when the victim changes her identification of the defendant, judges still will not believe the new testimony.[36] It is hard to imagine stronger evidence than the complainant herself testifying that the defendant did not commit the crime (absent evidence of improper motive). However, just as Judge Moore did in Troy Davis's case, most judges find that the new testimony is too unreliable to be the "clear and convincing" proof of innocence that the AEDPA requires.[37] As a

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[33] *See Davis*, 2010 WL 3385081, at *61 n.108.

[34] "There is no form of proof so unreliable as recanting testimony. In the popular mind it is often regarded as of great importance. Those experienced in the administration of the criminal law know well its untrustworthy character." People v. Shilitano, 112 N.E. 733, 736 (N.Y. 1916). *See* Cobb, *supra* note 13, at 983 ("While courts seldom articulate the judge's spontaneous skeptical reaction to recanting testimony as a reason for their hesitance to rely on such testimony, such reactions surely play a part in explaining the courts' distrustful regard of recantations.").

[35] *See* Rabner, *supra* note 12, at 1263 ("Nationwide, around 'seventy-five percent of convictions overturned due to DNA evidence involved eyewitness misidentification.'" (quoting State v. Henderson, 27 A.3d 872, 886 (N.J. 2011))); *supra* note 12 and accompanying text.

[36] *See, e.g.*, Shawn Armbrust, *Reevaluating Recanting Witnesses: Why the Red-Headed Stepchild of New Evidence Deserves Another Look*, 28 B.C. THIRD WORLD L.J. 75, 76 (2008) (citing People v. Dotson, 516 N.E.2d 718, 718–19, 721–22 (Ill. App. Ct. 1987)) (discussing the court's rejection of a rape victim's subsequent claim that the rape had not occurred); *Woman Recants a Rape Charge Six Years Later*, N.Y. TIMES, Mar. 30, 1985, at A6 (describing the *Dotson* victim's recantation, which the judge did not believe over her trial testimony).

[37] *See, e.g.*, United States v. Santiago, 837 F.2d 1545, 1550 (11th Cir. 1988) ("[R]ecantations are viewed with extreme suspicion by the courts."); United States v. Smith, 433 F.2d 149, 150–51 (5th Cir. 1970) ("Recantation is looked upon with the utmost suspicion." (quoting Newman v. United States, 238 F.2d 861, 862 n.1 (5th Cir. 1956))); Cobb, *supra* note 13, at 969–70 ("Recantations of testimony are strongly disfavored by the courts. Motions for new trial based upon such recantations are rarely granted . . . ."); Hill, *supra* note 10, at 227–29 (discussing credibility, additional supporting evidence, duress and coercion, and concern for finality as reasons for judicial skepticism toward recanted testimony).

result of this deeply rooted skepticism, reviewing judges rarely grant new trials based on recanted testimony.[38]

The skepticism toward recantation testimony arises from three places: doubts regarding the witness's credibility, policy concerns, and cognitive biases. First, with regard to credibility, the witness is seen as inherently unreliable by virtue of having lied—either on the stand or by falsely recanting.[39] Because recanting is tantamount to admitting to having committed a crime—perjury—the witness's motives for changing her testimony fall under serious question, and the court must consider the possibility of duress or coercion.[40] Moreover, the passage of time between testimony at trial and the ultimate recantation calls credibility and motive into question: The witness's memory of the crime itself has likely faded, making her new testimony seem less reliable and suggesting an improper motivation for recanting. The more time that passes, the more courts fear motives for recanting other than truthfulness, such as guilt over the defendant's incarceration, a close relationship with the defendant, improper influence and coercion, or even religious impetus.[41]

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[38] *See* Cobb, *supra* note 13, at 980 n.56, 981 (collecting sources to support the notion that "motions based on recanting testimony are seldom granted"); Janice J. Repka, Comment, *Rethinking the Standard for New Trial Motions Based upon Recantations as Newly Discovered Evidence*, 134 U. Pa. L. Rev. 1433, 1439–40 (1986) (citing only two such motions granted in the state of California and "few" in the federal system).

[39] *See* Armbrust, *supra* note 36, at 83 ("[C]ourts often interpret recantations as evidence of the unreliability of the witness, not the accuracy of the new testimony."); Christopher J. Sinnott, Note, *When Defendant Becomes the Victim: A Child's Recantation as Newly Discovered Evidence*, 41 Clev. St. L. Rev. 569, 575–76 (1993) (discussing problems associated with judicial skepticism toward recanted testimony).

[40] *See* Armbrust, *supra* note 36, at 85 (citing highly publicized instances of witnesses being "threatened or coerced before trials, particularly in gang and domestic violence cases" and prosecutors' prior experience with coerced witnesses as bases for this concern); Cobb, *supra* note 13, at 983–87 (discussing instances of courts determining, correctly or incorrectly, that recanted testimony was coerced); *see also* Armbrust, *supra* note 36, at 94–97 (offering instances of parties other than defendants improperly coercing witnesses at the original trial).

[41] *See, e.g.*, Armbrust, *supra* note 36, at 76 (describing speculation that the victim's recantation in *Dotson* was due to a subsequent religious epiphany motivating her to recant based on disagreement with the punishment; the conviction was subsequently falsified by DNA); Cobb, *supra* note 13, at 987–89 (proffering "the fact that recanting witnesses are often criminal accomplices or are otherwise closely associated with the offender" as one reason judges are so skeptical toward recants); Repka, *supra* note 38, at 1442 (describing the "long-standing judicial fear that the defendant is trying to manipulate the court by presenting a recantation induced by duress, bribery, or misplaced sympathy"); Joseph Berger, *Recanting a Sex Abuse Charge: Family Needs to Heal, but Which Statement Is the Lie?*, N.Y. Times, July 10, 1998, at B7 ("'It is our position that her recantation is a fabrication out of guilt of seeing her father go to jail and out of a desire to reconcile with her siblings,' said Louis Valvo, First Assistant District Attorney."); *Recanting of a Rape Charge Fails to Free Convict*, N.Y. Times, April 12, 1985, at D19 ("Mrs. Webb . . . said in

Second, as a policy matter, judges are concerned with finality, which is undermined if courts' final decisions are subject to the whims of unreliable witnesses.[42] Concerns with judicial economy also weigh against granting new trials absent the most persuasive forms of proof.[43] A related concern is potential manipulation, or the appearance of manipulation, of the criminal justice system.[44] Confidence in the judiciary is undermined every time a final judgment is overturned.[45] Thus, defendants attempting to present recantation evidence face overt hostility by the courts.[46]

Judges' unconscious thought processes also work against the defendant in this context in the form of cognitive biases. At least two cognitive biases operate on newly discovered evidence of innocence: "egocentric bias" and "status quo bias."[47] Egocentric bias inflates one's sense of one's own abilities and causes one to underestimate one's own chances of making a mistake. Judges may be hard-wired to believe that they or one of their colleagues would not have wrongfully convicted an innocent person, and will thus tend to discount evidence showing that the prior decision was incorrect.[48] Status quo bias causes one to prefer the current state of things to any change, because the status quo has become the reference point against which to compare

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court last week that religious beliefs caused her to recant the rape charge [against Gary Dotson.]").

[42] Courts are wary of recanted testimony, "lest the finality of trial verdicts be at the mercy of the scofflaw or unreliable witness." State v. Clark, 125 P.3d 1099, 1106 (Mont. 2005); *see also* United States v. Ugalde, 861 F.2d 802, 808 (5th Cir. 1988) (giving "great weight to society's interest in the finality of criminal convictions" in creating a test for newly discovered evidence); Cobb, *supra* note 13, at 991 ("The need for finality is among the most frequently cited justifications offered in support of the judicial system's reluctance to grant new trials.").

[43] *See* Armbrust, *supra* note 36, at 86 (citing courts' "general concern about finality and judicial economy" as a reason that they disfavor new trials based on recantations); Sinnott, *supra* note 39, at 577 ("Judicial economy . . . mandates that there be an end to successive litigation of the same issue."); *see also* Cobb, *supra* note 13, at 991–92 (noting finality and economy as arguments against the granting of a new trial); Repka, *supra* note 38, at 1443–44 (same).

[44] *See* Armbrust, *supra* note 36, at 86–87 (discussing judges' concern that recanting witnesses are attempting to manipulate the outcome of a judicial proceeding).

[45] *See* Cobb, *supra* note 13, at 991–92 (discussing policy reasons proffered against recantation evidence, including judicial finality and the disorder implicated by consistent invalidation of judicial decisions).

[46] *See, e.g.*, Hill, *supra* note 10, at 221 ("[C]ourts traditionally view witness recantations with hostility.").

[47] *See* Daniel S. Medwed, *Up the River Without a Procedure: Innocent Prisoners and Newly Discovered Non-DNA Evidence in State Courts*, 47 ARIZ. L. REV. 655, 700–08 (2005) (discussing egocentric and status quo biases in the context of judicial evaluation of newly discovered evidence); *see also* Armbrust, *supra* note 36, at 89–91 (discussing cognitive biases affecting judicial decisions on recanted testimony).

[48] *See* Medwed, *supra* note 47, at 701.

other possibilities. This tendency causes judges to require more evidence to prove innocence post-conviction than they would have at trial, which is neither rational nor consistent with AEDPA standards.[49] Tools to improve objectivity in decisionmaking, including Bayesian analysis, assist in minimizing unconscious biases by requiring that the decisionmaking process mimic that of a rational actor.[50]

For all of the above reasons—witness credibility issues, policy concerns, and cognitive biases—judges tend to see recantation evidence as presumptively untrustworthy. While this is not a formal presumption articulated in a legal standard, judges tend to operate as if it were.[51] But because the presumption is not formalized, there is no

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[49] *Id.* at 701–02. A rational actor weighs a piece of evidence without regard for earlier decisions; an actor influenced by status quo bias weighs evidence by reference to how it affects a defendant's guilt—effectively shifting the presumption of innocence to a presumption of guilt. The AEDPA, however, instructs judges to evaluate the entirety of the evidence, using a "clear and convincing evidence" standard, and decide whether a reasonable jury would still have convicted—not whether a reasonable jury would now reverse the conviction. *See supra* Part I.A. In contrast, status quo and other biases may lead judges to examine the evidence as a whole against the wrong reference point—the guilty verdict, as opposed to the presumption of innocence. Medwed, *supra* note 47, at 703–04 (suggesting that a guilty verdict "becomes the reference point to which a judge may look in assessing the new evidence," such that "it may require much greater evidence to prod the judge to move away from that reference point than had no verdict ever been rendered and, say, the judge were merely evaluating a motion to dismiss at the close of the prosecution's case at trial"). In Bayesian analysis, the prior ensures a consistent reference point, reducing the effect of status quo bias. *See infra* Part II.A.

[50] *See, e.g.*, John C. Harsanyi, *Bayesian Decision Theory, Subjective and Objective Probabilities, and Acceptance of Empirical Hypotheses*, 57 Synthese 341, 341 (1983) (describing the "very powerful analytical tools" provided by Bayesian analysis to overcome difficulties in making decisions based on incomplete information); Mike Oaksford & Nick Chater, Précis *of Bayesian Rationality: The Probabilistic Approach to Human Reasoning*, 32 Behav. & Brain Sci. 69–70 (2009) (defining "'Bayesian' rationality" as a rational model of human decisionmaking based on the probabilistic updating of subjective beliefs).

Bayesian theorists distinguish between subjective and objective probabilities. Subjective probabilities refer to a person's choice-based behavior, such as a 50% likelihood of betting "heads" on a coin toss, while objective probabilities refer to measurements of physical phenomena, that is the actual (objective) likelihood that the coin will land heads up. *See* Norman Fenton, Comment, *Improve Statistics in Court*, Nature, Nov. 3, 2011, at 37 ("Wider acceptance of Bayesian analysis also requires lawyers, expert witnesses and others to understand that there is a crucial difference between the genuinely disputable (subjective) prior assumptions, and the (objective) Bayesian calculations required to compute the conclusions from the different disputed assumptions."); Harsanyi, *supra*, at 343–44 (discussing Bayesian decision theory and distinguishing subjective probabilities and objective probabilities derived from external physical systems). Bayesian analysis provides a systematic way of incorporating *objective* probabilities into post-conviction judicial decisionmaking: Using probabilities of guilt derived from empirical research eliminates the need to rely on subjective assumptions about eyewitness accuracy. Furthermore, use of Bayes' Theorem ensures that these probabilities are applied consistently across witnesses by giving each (non-)identification appropriate weight.

[51] *See* Armbrust, *supra* note 36, at 82 ("Courts usually approach recantations with a presumption that they are incredible, which means that any defendant pursuing a new trial

clear or established manner in which to rebut it.[52] Furthermore, when a presumption does not reflect a legal reality, but is rather an unsubstantiated intuition about the properties of a category of evidence, the presumption can do more harm than good.[53] More generally, recanted testimony seems intuitively important, but the criminal justice system lacks consensus on the best way to interpret it. The result is public suspicion of injustice—in the form of the execution of an innocent man, for example—that may be worse than any lack of judicial finality.[54]

While the validity of the implicit, presumptive unreliability of recantation testimony has been called into question,[55] elimination of the presumption altogether would be difficult.[56] Scholars have suggested two possible solutions: (1) requiring corroboration of the recanted testimony or (2) relaxing the presumption of unreliability absent evidence of duress or coercion.[57] Recognizing that the

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based on a recantation is facing an uphill battle."); Repka, *supra* note 38, at 1442–45 (describing the judicial approach to recanted testimony as less than a formal presumption, but more than an inference of untrustworthiness).

[52] *See* Repka, *supra* note 38, at 1445 ("[W]hile the courts indulge the strong presumption that all recantations are somehow tainted, they do not articulate clearly how a defendant may rebut this presumption. Such a presumption may not be rebuttable at all in [many] situations . . . .").

[53] Professor Repka explains that a presumption ought to be reexamined and eliminated if its original purpose has been undermined. She concludes that the exceedingly high standard resulting from the presumption of unreliability of recanted testimony is not justified by either a verifiable pattern of facts or a lack of access to evidence, and therefore may be placing an undue burden on innocent defendants. *See id.* at 1442–47.

[54] *See* Cobb, *supra* note 13, at 993–96 (discussing policies that are at odds with the presumption of unreliability, including policies of resolving uncertainty in favor of criminal defendants and of encouraging untruthful witnesses to come forward with honest recantations, and concluding that "the extremity of the current legal position is not justified"); Repka, *supra* note 38, at 1442–45 (evaluating, and rejecting, policy justifications for the judicial presumption of unreliability); *Significant Doubts About Troy Davis' Guilt: A Case for Clemency*, NAACP, http://www.naacp.org/pages/troy-davis-a-case-for-clemency (last visited Sept. 18, 2013) ("[S]erious and unresolved doubts [about Davis's guilt] persist. These doubts put Georgia at risk of an irreversible and monumental mistake which could weaken public confidence in the justice system."); *see also supra* note 5 (citing public outcry about Davis's execution).

[55] *See, e.g.*, Cobb, *supra* note 13, at 1008–09; Repka, *supra* note 38, at 1444–45; Sinnott, *supra* note 39, at 590–92.

[56] *Cf.* Armbrust, *supra* note 36, at 88–91 (discussing cognitive biases affecting judicial interpretation of recanted testimony).

[57] *See, e.g.*, Armbrust, *supra* note 36, at 98–100 (proposing that courts require corroboration of a recanted identification, "rather than proof of truth," in part because the witness is often testifying to circumstances that do not lend themselves to definitive proof, such as conversations between the witness and the defendant); Adam Heder & Michael Goldsmith, *Recantations Reconsidered: A New Framework for Righting Wrongful Convictions*, 2012 UTAH L. REV. 99, 139 ("[W]e propose a corroboration requirement modeled after the one contained within Rule 803(b) of the Federal Rules of Evidence."); Repka, *supra* note 38, at 1454–56 (proposing a "Reasonable Possibility Approach").

presumption of unreliability likely continues to operate and skews what should be a more objective analysis of potentially probative new evidence,[58] this Note offers a third possible solution that seeks to provide the tools to weigh recanted testimony more objectively: the use of Bayesian analysis.

II
BAYESIAN ANALYSIS OF RECANTED EYEWITNESS IDENTIFICATION TESTIMONY

In this Part, I outline a method to evaluate recanted eyewitness testimony using Bayes' Theorem, a tool from probability theory that provides an algorithm for updating a defendant's likelihood of guilt (or innocence) based on new eyewitness identifications (or recanted identifications). Using Bayes' Theorem, one can account for the (in)accuracy of eyewitness identifications and determine precisely how identifications alter the probability that the defendant is guilty. Social scientists have extensively studied the accuracy of initial eyewitness identifications. This information can be used to update the probability that the defendant is guilty, providing a new estimate of how strongly one should believe in the defendant's guilt.

I first provide the building blocks for Bayes' Theorem, describing the relevant formulas and variables. I then apply the theorem to the *Davis* case to illustrate the theorem's applicability and import in practice. Starting with even odds of guilt and innocence, I calculate the updated probability that Davis was guilty given the nine positive eyewitness identifications at trial. Then, using the recantation evidence that came to light after trial, I update the probability that Davis was guilty in two different ways: the traditional manner that ignores the recantations completely, and the Bayesian manner that systematically accounts for recantations as new evidence, resulting in two identifications and seven nonidentifications.

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[58] *See* Armbrust, *supra* note 36, at 90–91 ("[T]he authority to employ subjective, rather than objective, factors will make it easier for judges who are experiencing [cognitive biases] to rationalize their decisions."); Hill, *supra* note 10, at 242 (arguing that Georgia should adopt the following procedural rule in order to ameliorate the effects of judicial disfavor of recantation testimony: "In criminal cases where the primary evidence supporting conviction is eyewitness testimony, an extraordinary motion for a new trial based upon evidence of witness recantations will not be dismissed without an evidentiary hearing."); *cf.* Armbrust, *supra* at 79 (pointing to "DNA exonerations [that] have proven . . . the reliability of certain recanting witnesses" and arguing that "the longstanding skepticism of the judiciary toward recantations deserves reexamination"); Cobb, *supra* note 13, at 996–97 (criticizing the "near-absolute rule that new trial motions based on recantations should not be granted except in the rarest of circumstances" and suggesting that "[s]ome middle ground is required, where all relevant policies and circumstances may be taken into account").

A.   Building Blocks: The Formulas and Variables in the Operation of Bayes' Theorem

1.   The Formulas

Bayesian analysis is a means to update one's belief in the likelihood of a proposition based on the addition of evidence for or against it.[59] In the context of a criminal trial, Bayesian analysis would show the factfinder how much the evidence presented at trial ought to alter his initial belief in the defendant's guilt. In Bayesian terms, this initial belief is called the *prior*. Bayes' Theorem provides the equation by which this prior is adjusted according to the persuasiveness of the evidence presented. Formally, Bayes' Theorem can be expressed as:

$$P(A|B) = \frac{P(B|A) \times P(A)P(B)}{P(B)}$$

In other words, to reach the *posterior probability* of A given B (the left-side term of the equation), divide the product of the probability of B given A and the prior probability of A (the numerator of the right-side term) by the prior probability of B (the denominator of the right-side term). The resulting belief in likelihood of guilt is called the *posterior*. This number, expressed as a probability that the defendant is guilty, is then compared to the standard of proof prescribed by law to determine whether the defendant should be found legally guilty.[60]

In the context of eyewitness identification evidence, Bayesian analysis can be used to accurately and systematically evaluate the effect of a positive identification on the probability that a defendant is guilty. Bayes' Theorem, when applied to evidence at trial, determines the posterior likelihood of guilt (*G*) given a positive identification (*ID*). This can be expressed as follows:

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[59] *See generally* Stephen E. Fienberg & Joseph B. Kadane, *The Presentation of Bayesian Statistical Analyses in Legal Proceedings*, 32 THE STATISTICIAN 88, 88–91 (1983) (defining Bayes' Theorem as applied to legal settings involving discrimination in jury selection); Stephen E. Fienberg & Mark J. Schervish, *The Relevance of Bayesian Inference for the Presentation of Statistical Evidence and for Legal Decisionmaking*, 66 B.U. L. REV. 771, 773–78 (1986) (discussing Bayesian interpretation of degrees of belief and Bayesian presentation of evidence); Michael O. Finkelstein & William B. Fairley, *A Bayesian Approach to Identification Evidence*, 83 HARV. L. REV. 489, 498–500 (1970) (defining Bayes' Theorem and proposing its application to identification evidence); Oaksford & Chater, *supra* note 50, at 69 (presenting "[t]he Bayesian perspective on human reasoning").

[60] *See, e.g.*, John Kaplan, *Decision Theory and the Factfinding Process*, 20 STAN. L. REV. 1065, 1083 (1968) (noting Bayes' Theorem does not "give the probabilities that a given statement is or is not true," but rather serves as "a rule for revising one's opinion about the probabilities of a hypothesis in the light of subsequently obtained evidence"). "[Bayes' Theorem] tells us how our previous estimates of probability should be influenced by the receipt of further data." *Id.*

$$P(G|ID) = \frac{P(ID|G) \times P(G)}{P(ID)}$$

Thus, in order to calculate the necessary values, the following information is needed: the defendant's prior likelihood of guilt $(P(G))$, the probability of a positive identification if the defendant is guilty $(P(ID|G))$, and the overall probability of an identification $(P(ID))$. The latter two numbers can be derived from social scientific studies of eyewitness identification accuracy rates.[61] The first number, the prior, is a topic of much contention in the Bayesian literature.[62]

Bayes' Theorem is also useful in this context because it allows us to combine pieces of evidence to update a prior based upon, for example, multiple (n) identifications. This can be expressed mathematically using the product rule:[63]

$$P(G|ID^n) = \frac{[P(ID|G) \times P(G)]^n}{P(ID)^n}$$

2. The Variables

a. The Prior

In the calculations below, I use a prior probability of guilt of 0.5, which can be conceptualized as equal likelihood of innocence or guilt. I do so for both practical and theoretical reasons. As a practical matter, beginning with 0.5 exerts the least influence on the posterior outcome compared to other priors.[64] In addition, laboratory studies of eyewitness identifications generally are controlled to a prior of 0.5.[65]

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[61] *See infra* Part II.A.2.b (discussing these studies).

[62] *See infra* Part II.B.2 (discussing the prior when using Bayesian analysis on the Davis case); *infra* Part III.A (discussing the strengths and weaknesses of various approaches to establishing the prior).

[63] This assumes independence of variables, meaning one identification does not influence a subsequent identification. Bayes' Theorem cannot be applied as described when the identifications display interdependency. *See* Finkelstein & Fairley, *supra* note 59, at 491–92 ("If traits are not independent, but rather tend to occur together, then the multiplication of the individual probabilities of each factor usually yields a composite probability that is far too small, even if the individual probabilities are accurate.").

[64] Beginning from a "balance" of guilt and innocence allows the evidence to tip the scales either towards guilt or towards innocence, depending on which the evidence favors. Other choices of priors assume the outcome should be weighted towards guilt or innocence. If, on the one hand, a prior close to zero is chosen, indicating almost certain innocence, a large amount of evidence will be required to overcome that presumption. On the other hand, if a prior close to one is chosen, this presumes almost certain guilt, and any evidence of innocence must have great weight to affect the outcome. A prior of 0.5 lets the evidence speak for itself. For further discussion of problems associated with selecting a prior, see *infra* Part III.A.

[65] *See* Steven E. Clark & Gary L. Wells, *On the Diagnosticity of Multiple-Witness Identifications*, 32 LAW & HUM. BEHAV. 406, 408 (2008) ("[T]he ratio of TP to TA lineups . . . is commonly set at a 1:1 ratio . . . .").

That is, there are equal numbers of study participants who view lineups including the guilty suspect and lineups in which the suspect is absent.[66] Because one cannot know the "real" probability that a defendant is guilty before any evidence is presented, some scholars pick 0.5 as a number as good as any other, and others suggest that a unique prior must be derived for each defendant.[67] I posit that 0.5 can be justified as the correct starting point for the analysis in this Note.[68]

b.   Eyewitness Accuracy Rates

This Note relies on a recently conducted meta-analysis of the body of eyewitness accuracy studies, which provides the accuracy rates for eyewitness identifications.[69] By analyzing the results of many studies, the authors discerned the likelihoods of certain eyewitness responses (*e.g.* correct identifications, no identification, incorrect

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[66] The effect, if any, of using a prior that does not match that of the studies used to obtain the probabilities for this Note's calculations is beyond the Note's scope. I leave investigation of this important question to future scholarship.

[67] "From a strict [subjective] Bayesian viewpoint, there is clearly no way in which one can say that one prior is better than any other." Barry C. Arnold & S. James Press, *Bayesian Inference for Pareto Populations*, 21 J. ECONOMETRICS 287, 296 (1983). For a discussion of the debate over selecting a prior, see *infra* Part III.A.

[68] The only evidence linking Davis to MacPhail's murder is the eyewitness testimony. Though inconsistent, one thing is clear from the testimony: Davis or Redd Coles—and no one else—fired the shot that killed MacPhail. Because the gun was never recovered and it is uncontested that Davis was in the parking lot that night, no further evidence exists implicating either Davis or Coles. *See* Billy Sinclair, *The Troy Davis Witnesses*, CAPITAL PUNISHMENT BOOK (Oct. 9, 2011), http://www.capitalpunishmentbook.com/?p=640 (detailing testimony of the various *Davis* witnesses, and concluding that "there were only two individuals in a physical position to be the shooter: Davis and Coles"). Thus, before accounting for the identification evidence, Davis and Coles have equal probabilities of guilt: 50%. While a 0.5 prior does not align so well with the facts of other cases, analysis of the method by which one would select the prior is beyond the scope of this Note, and a prior of 0.5 suffices to illustrate the concept I discuss here.

[69] Clark et al., *supra* note 12. A meta-analysis involves collecting a large group of studies evaluating a particular hypothesis, selecting those that meet pre-determined quality criteria, controlling for methodological and sample differences, and statistically analyzing the results from the entire group of experiments. The resulting conclusions drawn from the larger dataset are statistically more powerful than those drawn from smaller datasets. *See* Lawrence D. Cohn & Betsy J. Becker, *How Meta-Analysis Increases Statistical Power*, 8 PSYCHOL. METHODS 243, 243–44 (2003) (reviewing scholars' reasons for using meta-analysis, including an increase in statistical power—the ability to detect a phenomenon in the available sample); Esteban Walker et al., *Meta-Analysis: Its Strengths and Limitations*, 75 CLEV. CLINIC J. MED. 431, 437 (2008) ("The strength of meta-analysis is that, by pooling many studies, the effective sample size is greatly increased, and consequently more variables and outcomes can be examined."). *See generally* Alexander J. Sutton & Julian P.T. Higgins, *Recent Developments in Meta-Analysis,* 27 STATISTICS IN MEDICINE 625 (2008) (reviewing the history of meta-analysis and the evolution of meta-analytical methods).

identification) given a suspect's guilt and innocence.[70] Social science studies of eyewitness accuracy follow this general format: Participants witness the commission of a crime (either live or video recorded) and are asked to pick the culprit out of a lineup. The lineup is either Target Present (TP)—the culprit is one of the lineup members—or Target Absent (TA)—the culprit is not in the lineup. These studies are designed so that half of the participants view each type of lineup, creating a 0.5 prior probability of guilt for the dataset.[71] As each participant picks a suspect out of the lineup (or declines to select a suspect), their response is recorded as (1) a hit, identification of the culprit in a TP lineup; (2) a miss, a nonidentification in a TP lineup; (3) a foil, identification of someone other than the culprit; or (4) a nonidentification, the witness did not identify anyone.[72]

The meta-analysis reviewed ninety-four experiments adhering to this methodology and analyzed all of the data as if it came from a single study. The resulting accuracy rates are considered more representative of rates in the real world than those produced by any one study.[73] These data provide the probabilities needed to update a prior likelihood of guilt based upon different possible eyewitness responses. Table 1 below provides the key conditional probabilities:

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[70] *See* Clark et al., *supra* note 12, at 187–90 (describing purpose of their meta-analysis as answering the question: "What do the results of eyewitness identification experiments *typically* show?" (emphasis added)).

[71] *See* Clark & Wells, *supra* note 65, at 408 ("Experimenters have complete control over the prior probability of guilt by simply adjusting the ratio of TP to TA lineups, which is commonly set at a 1:1 ratio (i.e., 50% of eyewitnesses view TP lineups and 50% view TA lineups).").

[72] Only thirteen of the ninety-seven experiments included a fifth category, "don't know," which separates out witnesses who did not know if the culprit was present from those who affirmatively stated that the culprit was not present. *See* Clark et al., *supra* note 12, at 193 & tbl.3. As a result, the category "nonidentification" includes the following responses: "culprit is not there" and "I don't know if the culprit is there." In a real-world prosecution, all witnesses who view a lineup will ultimately be categorized in this way; either the witness identified the defendant or she did not. It makes no evidentiary difference *how* the witness did not identify. *See* Clark & Wells, *supra* note 65, at 406 ("[W]itnesses who fail to make an identification, or identify the wrong man, are not called [into court as witnesses]." (quoting Ruth Brandon & Christie Davies, Wrongful Imprisonment 30 (1973) (second alteration in original))); *cf.* Lisa Steele, *Trying Identification Cases: An Outline for Raising Eyewitness ID Issues*, 28 Champion 8, 8 n.3 (2004) ("Prosecutors build cases around witnesses who have identified a suspect; police may never tell a prosecutor about witnesses who did not identify the suspect, and those witnesses are rarely called into court.").

[73] *See* Cohn & Becker, *supra* note 69, at 244 ("A meta-analysis of such [smaller, low-power] studies, however, can increase the likelihood of detecting population effects."); Amit X. Garg et al., *Systematic Review and Meta-Analysis: When One Study Is Just Not Enough*, 3 Clinical J. Am. Soc. Nephrology 253, 254 (2008) ("Mathematically combining data from a series of well-conducted primary studies may provide a more precise estimate of the underlying 'true effect' than any individual study.").

TABLE 1. PROBABILITY VARIABLES

	Conditional Probabilities[74]		Prior Probabilities	
	TP	TA		
ID	.461 $P(ID\,|\,G)$	.134 $P(ID\,|\,{\sim}G)$	$P(G)$	.5
Non-ID	.327 $P({\sim}ID\,|\,G)$	.520 $P({\sim}ID\,|\,{\sim}G)$	$P({\sim}G)$	.5

Accordingly, if the suspect is in the lineup (TP), the probability of a hit is 46.1% and the probability of a miss is 32.7%. If the suspect is not in the lineup (TA), the probability of a foil being selected is 13.4% and the probability of a nonidentification is 52%. As shown below, these rates can be used to calculate the effects that additional correct identifications or nonidentifications can have on prior probabilities of guilt.

c. Probability of Guilt Given a Correct Identification

The overall probability of guilt given an identification is expressed formally below in Equation 1.

EQUATION 1[75]

$$P(G|ID) = \frac{P(ID|G){\times}P(G)}{P(ID|G){\times}P(G)+P(ID|{\sim}G){\times}P({\sim}G)}$$

Given a prior probability of guilt of 50%, only the likelihoods of an identification given a suspect's guilt and a suspect's innocence ($P(ID\,|\,G)$ and $P(ID\,|\,{\sim}G)$)) are needed in order to determine the overall probability of guilt given an identification. The probability of an identification given a suspect's guilt, $P(ID\,|\,G)$ is simply the hit rate. If the suspect is in the lineup, the probability of the witness

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74 Clark et al., *supra* note 12, at 192 tbl.2.

75 *See* Clark & Wells, *supra* note 65, at 408 (providing the equation for overall likelihood of guilt given an identification). Recall that the initial expression of Bayes' Theorem in the eyewitness evidence context, *supra* Part II.A.1, contained only $P(ID)$ in the denominator. The overall (prior) probability of an identification, $P(ID)$, is found by summing together the product of the hit rate and the prior probability of guilt with the product of the foil rate and the prior probability of innocence. Because we know the prior probabilities of guilt and innocence, $P(G)$ and $P({\sim}G)$, and the conditional probabilities, $P(ID\,|\,G)$ and $P(ID\,|\,{\sim}G)$, *infra* note 76 and accompanying text, we can solve for the prior likelihood of identification: $P(ID) = P(ID\,|\,G){\times}P(G)+P(ID\,|\,{\sim}G){\times}P({\sim}G)$. Clark & Wells, *supra*, at 408. This explains the expression in the denominator of Equation 1.

identifying him is 46%.[76] The probability of an identification given a suspect's innocence is 13.4%.[77]

Thus, plugging these numbers into Equation 1 demonstrates that the probability of guilt, given a positive identification, is 77%. This represents the posterior likelihood of guilt, having used Bayes' Theorem to update the prior to account for one eyewitness identification. Bayes' Theorem allows for a proper evaluation of this evidence according to how accurate such identifications are. Stated differently, a single eyewitness identification increases the defendant's likelihood of guilt by twenty-seven percentage points (from a prior probability of 50% to a posterior probability of 77%).

d. Probability of Guilt Given a Nonidentification

The meta-analysis also provides the probabilities needed to analyze the effect of recanted identification testimony. For analytical purposes, I treat recanted identifications as part of the "nonidentification" category. This category thus includes both negative responses ("he is not the culprit") and "don't know" responses ("I don't know who the culprit was").[78] The probabilities necessary to update a prior based on a nonidentification, expressed formally in Equation 2 below, are the likelihood of a nonidentification given guilt, $P(\sim ID \mid G)$, the likelihood of a nonidentification given innocence, $P(\sim ID \mid \sim G)$, and the overall probability of a nonidentification, $P(\sim ID)$.

$$\text{EQUATION 2}$$
$$P(G|\sim ID) = \frac{P(\sim ID|G) \times P(G)}{P(\sim ID|G) \times P(G) + P(\sim ID|\sim G) \times P(\sim G)}$$

Using the probabilities from the meta-analysis[79] and prior probabilities of 50% for guilt and innocence, Equation 2 provides that the posterior probability of guilt given a nonidentification is 39%. That is, a nonidentification reduces the probability of guilt by eleven percentage points (from a prior probability of 50% to a posterior probability of 39%).

Having used Bayes' Theorem to calculate the effects of single additional pieces of evidence (either a positive identification or nonidentification), I will next explain how the theory can be used to analyze the effects of multiple additional pieces of evidence. I will

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[76] $P(ID \mid G) = 0.461$. *See supra* Table 1.

[77] $P(ID \mid \sim G) = 0.134$. *See id.*

[78] *See supra* note 72 (explaining this distinction). "Don't know" data is collapsed into the "non-ID" category as noted in Clark et al., *supra* note 12, at 188.

[79] $P(\sim ID \mid G) = 0.327$ and $P(\sim ID \mid \sim G) = 0.520$. *See supra* Table 1.

examine the *Davis* case, and will explain how Bayes' Theorem can provide a more objective and systematic accounting of how the probability of Davis's guilt should have been adjusted, given the seven instances of recanted testimony.

B.   Analysis of Davis *Witnesses*

1.   Trial

At trial, nine witnesses identified Davis as the shooter. For ease of illustration, I assume that all nine identifications are eyewitnesses who would have picked Davis out of the lineup; in practice, only eye-witnesses should be included in this particular calculation.[80] To implement Bayes' Theorem, we use the product rule:

<div align="center">

EQUATION 3

$$P(G|ID^n) = \frac{[P(ID|G) \times P(G)]^n}{[P(ID|G) \times P(G) + P(ID|\sim G) \times P(\sim G)]^n}$$

</div>

Plugging in the probabilities derived above in Part II.A.2,

$$P(G|ID^n) = \frac{[.461 \times .5]^9}{[(.461 \times .5) + (.134 \times .5)]^9}$$

The resulting likelihood of guilt is 99.9985%. Even absent any other evidence linking Davis to the murder, a reasonable juror could conclude that this set of identifications established Davis's guilt "beyond a reasonable doubt."

2.   Post-Conviction Hearing

Recall from Part I that upon reviewing the Davis case after trial and conviction, Judge Moore discounted all seven recanting witnesses and concluded that the two remaining witness identifications were sufficient to support a conviction—despite no other evidence bearing on Davis's guilt. The AEDPA, however, requires the reviewing court to make a probabilistic assessment of *all the evidence taken as a whole* to determine whether a rational jury would still have found the defendant guilty.[81] The "whole" of the evidence means the totality of evidence presented at trial; if a piece of evidence now weighs against the defendant's guilt, this should be accounted for in the same manner as

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[80] The probabilities used in Clark et al.'s meta-analysis result from lineup identification experiments. They are accurate for evaluating this type of identification but may not apply to non-lineup situations. *See* Clark et al., *supra* note 12, at 190 ("Only experiments that presented both TP and TA lineups were included in the analysis [and] only experiments using single-suspect lineups with adults as subjects."). Further research is needed into accuracy rates for other types of identifications. *See id.* at 188 (listing meta-analyses of eyewitness accuracy research, all of which study lineup-related effects).

[81] *See* AEDPA § 106, 28 U.S.C. § 2244(b)(2)(B)(ii) (2006).

evidence that continues to weigh in favor of the defendant's guilt. A comparison of two calculations—Davis's likelihood of guilt given two positive identifications, and Davis's likelihood of guilt given two identifications and seven nonidentifications—illustrates the difference between the proper AEDPA approach and Judge Moore's (incorrect) approach.

a.   Two Positive Identifications

Davis's posterior probability of guilt given two positive identifications can be analyzed with the same formula used to determine Davis's posterior probability of guilt at trial, given nine positive identifications (*i.e.*, using Equation 3):

$$= \frac{[.461 \times .5]^2}{[(.461 \times .5) + (.134 \times .5)]^2}$$

The resulting likelihood of guilt is 92.2%. A 92% probability of guilt may well satisfy the "beyond a reasonable doubt" standard,[82] and a reduction of only seven percentage points in the probability of guilt likely does not meet the "clear and convincing evidence" standard required to grant a new trial under the AEDPA.[83] From a non-Bayesian perspective that ignores the effect of seven new nonidentifications, Judge Moore's decision seems correct.

b.   Two Positive Identifications and Seven Nonidentifications

A more accurate method with which to analyze the recanted testimony would apply Bayesian inference to the *whole body* of evidence present at trial, as required by the AEDPA. The effect of a nonidentification is less obvious than the effect of a positive identification, which clearly increases the accused's probability of guilt.[84] But

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[82] Scholars and judicial actors have suggested numbers ranging from sixty to ninety-nine percent as equivalent to "beyond a reasonable doubt." Values within the ninety to ninety-five percent range are given frequently as satisfying the standard of proof. *See, e.g.*, Peter Tillers & Jonathan Gottfried, Case Comment, United States v. Copeland*, 369 F. Supp. 2d 275 (E.D.N.Y. 2005): A Collateral Attack on the Legal Maxim that Proof Beyond a Reasonable Doubt Is Unquantifiable?*, 5 Law, Probability & Risk 135, 135–38 (2007) (discussing various attempts by judicial actors to quantify "beyond a reasonable doubt" as a numerical probability of guilt, including prosecutors' use of sports analogies to explain the concept to jurors).

[83] *See* AEDPA § 106, 28 U.S.C. § 2244(b)(2)(B)(ii) (2006).

[84] The relationship between nonidentifications and the guilt of a defendant is unclear intuitively. We know from experience that identifications increase the likelihood that a defendant is guilty, but most people have far less experience with nonidentifications. *Cf.* Gary L. Wells & R.C.L. Lindsay, *On Estimating the Diagnosticity of Eyewitness Nonidentifications*, 88 Psychol. Bull. 776, 777, 783 (1980) ("[T]he criminal justice system has largely ignored nonidentifications. . . . [I]f nonidentification witnesses are not a part of the sample appearing in court, one cannot be confronted with evidence that there is a

nonidentification evidence need not be ignored because its effects are not intuitive; the difficulty can be ameliorated by attempting to quantify these effects using Bayes' Theorem. Bayesian inference allows us to apply eyewitness accuracy rates to nonidentifications and to systematically update the defendant's probability of guilt using that information. Combining Equations 2 and 3 above provides us with a fourth equation that encompasses the effects of both positive identifications and nonidentifications on probabilities of guilt:

<div align="center">

EQUATION 4

$$\frac{[P(ID|G)\times P(G)]^2\times[P(\sim ID|G)\times P(G)]^7}{[P(ID|G)\times P(G)]^2\times[P(\sim ID|G)\times P(G)]^7+[P(ID|\sim G)\times P(\sim G)]^2\times[P(\sim ID|\sim G)\times P(\sim G)]^7}$$

</div>

Using the probabilities derived above:

$$=\frac{[.461\times.5]^2\times[.327\times.5]^7}{[.461\times.5]^2\times[.327\times.5]^7+[.134\times.5]^2\times[.520\times.5]^7}$$

The posterior probability of guilt here is 31.5%. The original 99% posterior probability of guilt, given the nine positive identifications at trial, drops by nearly seventy percentage points when updated to reflect a new universe of evidence that includes two positive identifications *as well as* the seven nonidentifications. In light of the AEDPA's "clear and convincing" standard, such a dramatic reduction at least deserves a more robust discussion than Judge Moore provided. The decision of whether to grant a new trial should have been more expressly informed by the Bayesian analysis provided above, which demonstrates that an update of probabilities incorporating seven nonidentifications leads to the conclusion that Davis was *more likely than not* innocent.[85] These results are not meant to represent Troy Davis's true likelihood of guilt. Rather, I argue that an updated likelihood of guilt, after accounting for the recanted identifications, may very well have demanded that the motion for a new trial be granted.[86]

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positive relationship between nonidentifications and the likelihood of the suspects' innocence."). Social scientists, however, create this experience in the laboratory and we can thus determine the effect of nonidentifications on probability of guilt. *See, e.g.*, *id.* (demonstrating empirically that in any situation in which an identification is diagnostic of guilt, a nonidentification is also diagnostic of innocence).

[85] The resulting probability indicates that Davis's posterior likelihood of guilt is less than 50%, meaning he was more likely innocent than guilty—if this set of identifications and nonidentifications accurately represents the witness's beliefs.

[86] It is possible that the updated probability of guilt would also deter prosecutors from pursuing a new trial. On the other hand, while DNA evidence is generally seen as an incontrovertible form of exoneration evidence, some prosecutors choose to pursue retrials despite exonerating DNA evidence. *Compare, e.g.*, Armbrust, *supra* note 36, at 77 (discussing the "ever-increasing numbers" of innocent people exonerated by DNA evidence and its near-universal acceptance as conclusive evidence of innocence), *with* Andrew

In sum, by considering the effect that the recanted testimony would have on the likelihood of defendant's guilt were it completely credible, reviewing courts can better judge whether the defendant has made a "clear and convincing" showing that a reasonable juror would not have convicted the defendant.[87] Bayesian inference provides an objective way to weigh recantation evidence that avoids some of the cognitive biases that lead judges to discount it out of hand.

III
BAYESIAN ANALYSIS CAN BE EFFECTIVELY IMPLEMENTED TO EVALUATE RECANTED EYEWITNESS IDENTIFICATION TESTIMONY

Despite scholars' arguments for its applicability in various legal settings,[88] Bayesian inference has failed to gain traction in the courtroom context.[89] The choice of prior and the feasibility of using probabilistic statistics in jury trials have been hotly contested topics in both Bayesian and Bayesioskeptic camps. This Part argues that Bayesian analysis is especially suited to evaluating recanted eyewitness identification evidence. First, it suggests ways to resolve potential problems in selecting priors in the habeas context. Second, it argues that the specific context of post-conviction habeas hearings on recanted eyewitness evidence eliminates the most vexing problems of implementation. Finally, it concludes with a brief discussion of policy arguments in favor of using Bayesian analysis in this context.

A. Selecting the Prior

The choice of prior must be, to some degree, arbitrary in the trial context because the probability of a defendant's guilt before any evidence is presented cannot be known. One common suggestion is to

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Martin, *The Prosecution's Case Against DNA*, N.Y. TIMES MAG., Nov. 27, 2011, at M44, *available at* http://www.nytimes.com/2011/11/27/magazine/dna-evidence-lake-county.html?pagewanted=all (listing examples of prosecutors positing alternative theories, such as the "unindicted co-ejaculator" theory for the presence of nonmatching semen, in response to a defendant's DNA evidence (internal quotation marks omitted)).

[87] For a discussion of incorporating credibility evaluations and Bayesian analysis, see *infra* notes 107–109 and accompanying text.

[88] *See generally* Fenton, *supra* note 50 (arguing for wider application of Bayesian methods to legal evidence); Fienberg & Kadane, *supra* note 59, 93–95 (discussing the Bayesian approach to interpreting legal concepts and applying Bayesian analysis to jury determinations); Fienberg & Schervish, *supra* note 59 (describing Bayesian presentation of statistical evidence); Finkelstein & Fairley, *supra* note 59 (describing Bayesian interpretation of identification evidence).

[89] *See, e.g.*, Fenton, *supra* note 50, at 37 ("Despite its potential utility, Bayes' theorem is not trusted by much of the legal profession.").

start with "even odds" that either side will prevail.[90] Others suggest this fifty-fifty treatment is inappropriate for various reasons, including that it leads to indeterminacy and that, at least in the criminal justice system, jurors are not to allow the fact that the defendant has been arrested, indicted, and brought to trial bear on their assessment of his guilt.[91] That is, jurors are to operate under a constitutionally mandated "presumption of innocence" for the defendant.[92] But in the mathematical application of Bayes' Theorem, the prior cannot be zero because such a representation would indicate complete belief in the defendant's innocence, a belief that will not be shaken by any additional evidence.[93] As a result, in order to capture the presumption of innocence, but still allow the introduction of evidence to have an effect on the court's conception of innocence or guilt, some scholars suggest that the prior should be set somewhere higher than zero, but still very low.[94]

To address the problem in a habeas hearing, one possibility is to run the analysis using different priors, which, rather than providing a single posterior probability, would result in a range of possible posteriors. If the evidence is strong enough, even a low prior can lead to

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[90] For example, Judge Richard Posner of the Seventh Circuit looks favorably on starting a trial with even odds. *See* Richard A. Posner, *An Economic Approach to the Law of Evidence*, 51 STAN. L. REV. 1477, 1508, 1514 (1999) (recommending that triers of fact begin with the assumption that the prosecution's case is no more likely than not meritorious). In probability theory, odds of zero represent certainty that a proposition is false; infinitely high odds represent certainty that a proposition is true; and "even odds" of 1:1 or 50/50 means that the proposition is equally likely to be true or to be false. These odds correspond to probabilities of 0.0, 1.0, and 0.5, respectively. *See* Richard D. Friedman, *A Presumption of Innocence, Not of Even Odds*, 52 STAN. L. REV. 873, 874 (2000).

[91] *See, e.g.*, Kaplan, *supra* note 60, at 1085–86 (arguing that Bayes' Theorem does not "solve the problem of measuring . . . the initial odds on guilt," and noting that one could interpret the presumption of innocence instruction to mean that the initial odds on guilt are to be considered "quite small," perhaps 1:200 million, because the "defendant is no more likely a priori to be the guilty party . . . than is anyone else in the United States"). For a discussion of various philosophical approaches to selecting a Bayesian prior, see James Berger, *The Case for Objective Bayesian Analysis*, 1 BAYESIAN ANALYSIS 385, 386–87 (2006).

[92] The presumption of innocence, which functions as the prior in a trial setting, should not be confused with the burden of persuasion, which is the probability of guilt required for a conviction. *See* Friedman, *supra* note 90, at 883.

[93] *Id.* at 881; Fienberg & Schervish, *supra* note 59, at 780.

[94] Jurors could be instructed to set the prior probability of guilt very low, but to base it on their own experience with the world. Professor Friedman provides sample jury instructions to illustrate this approach. He reasons that the jury should be instructed to "not treat the bringing of the accusation, or the prosecutor's opening statement, as evidence that the accused committed the crime charged." Friedman, *supra* note 90, at 882 (proposing a sample jury instruction indicating a very low probability of guilt as a starting point). *But see* Fienberg & Schervish, *supra* note 59, at 780 (discussing the "somewhat uncomfortable presumption that each juror has some prior probability of finding guilt . . . before presentation of the evidence").

significant posterior probabilities.[95] As a result, a judge presiding over a habeas hearing could select the highest prior he deems reasonable and check to see if the associated posterior meets the standard for a new trial. If it did, the exact prior would not matter because any prior lower than that selected would also meet the standard.[96]

B.   *The Post-Conviction Habeas Hearing Context*

Scholars have debated the positive and normative benefits of using Bayesian inferential methods in the trial setting. Professors Ronald Allen and Richard Friedman laid out the contours of the debate in a special issue of the *International Journal of Evidence and Proof*.[97]

There is a discrete set of nonissues on which Bayesian enthusiasts and Bayesioskeptics agree: the validity of Bayes' Theorem and probability theory; the proposition that Bayes' Theorem represents a normative judicial ideal, meaning the outcome of the factfinder's decisionmaking should align with the theorem were it possible to implement; and the possibility that the application of Bayes' Theorem would be useful or desirable in future settings.[98]

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[95] *See* Finkelstein & Fairley, *supra* note 59, at 500 & tbl.I (1970) (providing posterior probabilities for a range of possible priors); Appendix, *infra* (same); *see also, e.g.*, Michael E. Alfaro & Mark T. Holder, *The Posterior and the Prior in Bayesian Phylogenetics*, 37 ANN. REV. ECOLOGY EVOLUTION & SYSTEMATICS 19, 34 (2006) ("For large trees, all clades have a low prior, and empirically, only modest amounts of data appear necessary to result in high [posterior probabilities], even for clades that are assigned relatively low prior probabilities."); William C. Thompson, et al., *How the Probability of a False Positive Affects the Value of DNA Evidence*, 48 J. FORENSIC SCI. 1, 4 tbl.1 (2003) (listing a wide range of posteriors resulting from a given prior, in the context of DNA matching).

[96] Regardless of how one selects the prior, "choosing specific priors and acting on them in a consistent manner [has] potential advantages." Harsanyi, *supra* note 50, at 352 (describing two potential advantages of consistently acting on a chosen prior).

[97] Ronald J. Allen, *Rationality, Algorithms and Juridical Proof: A Preliminary Inquiry*, 1 INT'L J. EVIDENCE & PROOF 254 (1997) (presenting the Bayesioskeptical position against the use of Bayesian inference by factfinders to determine the outcome of a trial); *see also* Richard D. Friedman, *Answering the Bayesioskeptical Challenge*, 1 INT'L J. EVIDENCE & PROOF 276 (1997) (responding to the twelve points made by Allen, *supra*, and arguing that Bayesian methods are most useful as analytical tools to those who study evidentiary law and should not generally be implemented directly by factfinders); *cf.* Fienberg & Schervish, *supra* note 59, at 782–94 (discussing the standard Bayesioskeptic arguments and offering responses).

[98] Allen, *supra* note 97, at 256–60 (pointing to issues in the Bayesianism debate that are defended by one side but not actually contested by the other side). Allen leaves the door open for using Bayes' Theorem in certain evidentiary contexts—specifically, those "involving virtually purely statistical evidential bases" or even "in some extremely impoverished nonstatistical evidential settings," as compared to the "typical juridical context involving a rich, highly complex set of interdependent pieces of evidence," for which Bayes' Theorem would be less helpful. *Id.* at 258.

The major disagreements between Bayesian enthusiasts and Bayesioskeptics center on whether implementation of Bayesian methods in the trial setting is feasible and, if feasible, whether its application in this context is desirable. First, Bayesioskeptics present compelling arguments regarding the average juror's ability to implement Bayesian inference to evaluate trial evidence. The challenge of estimating the probabilities of various events occurring, especially the conditional probabilities of events occurring together, combined with the large number of variables required for most trials makes it difficult for juries to effectively perform Bayesian analyses.[99]

However, these concerns are less relevant when applied to habeas hearings on recanted evidence. Because recantation testimony is presented post-conviction, no jury is expected to perform the calculations detailed above. Rather, in this context, a judge, defense attorney, or expert would perform the calculations.[100] Further, because the prior may be the only variable to change between defendants, the posterior would not necessarily need to be recalculated for every case. The posteriors resulting from different priors can be precalculated and tabulated to obviate case-by-case computations.[101] This strategy would also increase objectivity while reducing the inconsistencies and expenses associated with selecting conditional probabilities. Accusations of bias in the selection of probabilities will carry less weight if the precalculated posteriors are based on conditional probabilities derived from empirical data applied equally to every case.[102] Furthermore, post-conviction evidence is not reviewed by a lay jury, but by a judge experienced in applying legal standards. The

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[99] "[T]o deal with dependent evidence, one must form $2n$ probability assessments of all the possible conjunctions of the pieces of evidence, where n is the number of pieces of data to be incorporated into the posterior judgment." *Id.* at 263–64. Therefore, updating a prior based on ten pieces of evidence requires a thousand probabilities, and thirty pieces of evidence requires roughly a billion probabilities. Of course, real trials often involve far more than thirty pieces of evidence. *Id.*; *see also* Friedman, *supra* note 97, at 288–91 (discussing the computational complexity of applying Bayes' Theorem "in its most powerful gear" and suggesting that Bayes' Theorem is still a useful way to describe statistical evidence, even if asking the jury to perform the calculations would be infeasible). Courts are similarly wary of asking jurors to employ complex statistics. *See, e.g.*, People v. Collins, 438 P.2d 33, 33 (Cal. 1968) ("Mathematics, a veritable sorcerer in our computerized society, while assisting the trier of fact in the search for truth, must not cast a spell over him.").

[100] Once eyewitness accuracy rates are established, the only variables that will change by case are (1) the prior, and (2) the number of identifying and nonidentifying witnesses. The calculations can then be performed by a computer program. I provide a tool to do so at http://www.nyulawreview.org/fields-calculator.

[101] For a set of tables eliminating the need to perform Bayesian calculations, see Appendix, *infra*.

[102] The remaining discretion, and potential risk of bias, involves selection of the prior as discussed in *supra* Part III.A.

concepts of probability of guilt and standard of proof are familiar to judges. Thus, judges should be especially adept at conceptualizing the application of Bayesian results to the AEDPA's "clear and convincing evidence" standard for a new trial.[103]

Bayesioskeptics further claim that Bayesian inference should not be used in a trial setting because it does not fit naturally with human decisionmaking.[104] Factfinders will be subject to cognitive biases and heuristics common to human decisionmaking. Jurors in particular are plagued by imperfect information, rigid but often unclear instructions, and group dynamics.[105] However, eyewitness identifications are statistically quantifiable in much the same way trace evidence is.[106] When evaluating recanted testimony, therefore, judges can mechanically compare the likelihood of guilt following trial with the likelihood of guilt given a change in the constellation of witnesses, as the analysis in Part II demonstrates. This reduces the need for a judge to rely solely on an intuition about the credibility of the recantation, which could reduce the risk of succumbing to potential cognitive pitfalls. If the posterior probability that the defendant is innocent becomes high enough, a new trial can be granted and a new jury can perform the credibility evaluation.

Another possible criticism is that Bayesian inference is overly polarized because it does not account for varying levels of credibility. It is certainly reasonable for a judge to evaluate testimony as neither completely true nor completely false. Bayes' Theorem indeed does not account for a continuum of credibility. But this does not foreclose its usefulness. Bayesian analysis gives the judge an objective way to

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[103] AEDPA § 106, 28 U.S.C. § 2244(b)(2)(B)(ii) (2006).

[104] *See, e.g.*, L. Jonathan Cohen, *Can Human Irrationality Be Experimentally Demonstrated?* 4 BEHAV. & BRAIN SCI. 317, 328–30 (1981) (arguing that probabilistic reasoning is not congruent with actual human decisionmaking); Nancy Pennington & Reid Hastie, *Evidence Evaluation in Complex Decision Making*, 51 J. PERSONALITY & SOC. PSYCHOL. 242, 243 (1986) (positing a non-probabilistic, "Story Model" of juror decisionmaking). *But see* Fienberg & Schervish, *supra* note 59, at 791–93 (acknowledging that humans generally do not adhere to the "basic rules of probability and their consequences" but arguing that Bayesian results are a proper normative ideal).

[105] *See, e.g.*, Allen, *supra* note 97, at 261–62 (discussing the staggered presentation of legal standards to jurors, where instructions containing each element are given only after all evidence is presented); Robert J. MacCoun, *Experimental Research on Jury Decision-Making*, 244 SCIENCE 1046 (1989) (presenting evidence of juror dynamics during trial and deliberations, including biases, informational inequities, and the effects of different jury instruction structures on the decisionmaking process). For an anecdotal account of these factors operating on jury deliberations in a criminal trial, see D. GRAHAM BURNETT, A TRIAL BY JURY 79–178 (2002).

[106] *See* Finkelstein & Fairley, *supra* note 59, at 498–501 (applying Bayes' Theorem to trace evidence such as handprints); *see also* Clark & Wells, *supra* note 65 (applying Bayes' Theorem to eyewitness identification reliability).

determine what the effect would be, if the jury were to find the recantation testimony credible. Even completely honest eyewitnesses are often inaccurate. Thus, Bayesian analysis is a useful tool to account for the effects of eyewitness inaccuracy but does not replace the eventual credibility determination. It rather clarifies the difference between intuitive doubt regarding witness credibility and a distinct intuion regarding the effect of a nonidentification.

A benefit of Bayesian analysis is the ability to use judgment and intuition in selecting the prior.[107] As discussed above, there is no consensus as to the "correct" prior to choose, and a judge's knowledge and experience can provide rational bounds for selecting the prior likelihood of guilt.[108] Furthermore, Bayesian methods can provide guidance to judicial decisionmakers employing traditional methods of inquiry.[109] An approach employing Bayesian analysis in concert with traditional judicial decisionmaking is less suceptible to the influence of cognitive biases and is therefore an improvement over the current method of evaluating recantations.

C.   Policy Considerations

Several policy arguments support the use of Bayesian inference in the context of habeas hearings over recanted identifications. Results can be generated quickly and cheaply, which promotes judicial economy. Concerns with economy influence the AEDPA's restrictions on successive habeas petitions; Congress did not want federal dockets clogged with repetitive petitions for habeas relief. Counsel could brief

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[107] *See* Harsanyi, *supra* note 50, at 352 ("[I]t is an important advantage of the Bayesian approach that it enables us to make use of our unreasoned, spontaneous, intuitive judgments in making our decisions. (But, of course, it also encourages us to study our past record to find out how good our intuitive judgments really are.)").

[108] *See id.* at 351 (discussing "rationalist" and "subjectivist" methods of selecting a prior and suggesting that rational criteria help to "make the best possible use of the *information* available to us in choosing our prior probabilities"); Oaksford & Chater, *supra* note 50, at 75–76 (describing the advantages of Bayesian analysis in situations in which the decisionmaker has some information about the prior).

[109] Consider a case in which some outside evidence strongly indicates that a certain recantation is not truthful (*i.e.*, evidence beyond the subjective factors discussed above). The judge could perform the Bayesian analysis twice, once including the recantation evidence as a nonidentification, and again including that witness as an identification. The judge can then see how the outcome would change if the jury believed the recantation testimony. Depending on the strength of other available evidence, the testimony of one eyewitness may or may not strongly affect the defendant's likelihood of guilt. This method is still susceptible to the problems with subjective intuition; however, performing a more objective evaluation of the evidence will help to break the judge out of the "tunnel vision" caused by inherent skepticism and cognitive biases, thereby reducing its influence on his decisionmaking process. *See* Armbrust, *supra* note 36, at 90–91 (discussing concerns with judicial tunnel vision resulting from reliance on subjective factors in evaluating recantation evidence).

the court on the possible posterior probabilities of guilt resulting from the new evidence, thereby eliminating the need for the certificate of appealability panel to make credibility judgments at that stage—if the posterior likelihood that the defendant is innocent is sufficiently high, the certificate should be granted and credibility assessments should be left to the hearing or a new trial. Moreover, employing a systematic analysis of recanted identifications would increase consistency in judgments and thus confidence in the criminal justice system. By articulating more objective reasons for refusing to grant new trials than the popular "neither testimony is convincing, so the judgment stands," judges can reduce the appearance of arbitrary imposition of the death penalty and other punishments.[110] Applying Bayesian inference to recanted eyewitness identifications, then, would improve the accuracy of outcomes, increase efficiency, and enhance confidence in the criminal justice system.

CONCLUSION

This Note has argued that judges evaluating recanted eyewitness identifications in habeas proceedings should consider implementing Bayesian inference. Applying this method will lead to more consistent and accurate outcomes in cases involving recanted testimony. While such methods may not be appropriate in all legal settings, typical anti-Bayesian arguments are weakest in the context of post-conviction habeas hearings on eyewitness testimony. Given the strong judicial skepticism of recanted testimony and the potential cognitive pitfalls in evaluating it, Bayesian analysis can provide more reliable and accurate outcomes in the context of post-conviction eyewitness recantations and potentially avoid the ultimate injustice of imprisoning or executing an innocent person.

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[110] Such arbitrariness has lead to specific impositions of capital punishment being struck down as unconstitutional. *See* Furman v. Georgia, 408 U.S. 238, 239–40 (1972) (per curiam) (finding the death penalty in three cases violated the Eight and Fourteenth Amendments). Therefore, any appearance of arbitrary or capricious imposition of the death penalty should be addressed to the extent possible.

APPENDIX: POSTERIOR PROBABILITIES OF GUILT FOR GIVEN PRIORS AND NUMBERS OF EYEWITNESS IDENTIFICATIONS

Prior ID, NonID	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
One Witness									
1, 0	27.65%	46.24%	59.59%	69.64%	77.48%	83.77%	88.92%	93.23%	96.87%
0, 1	6.53%	13.59%	21.23%	29.54%	38.61%	48.54%	59.47%	71.55%	84.98%
Two Witnesses									
2, 0	12.75%	42.52%	68.49%	84.03%	92.21%	96.38%	98.47%	99.48%	99.90%
1, 1	2.60%	11.91%	28.44%	49.02%	68.39%	82.96%	92.17%	97.19%	99.43%
0, 2	0.49%	2.41%	6.77%	14.95%	28.34%	47.08%	68.28%	86.35%	96.97%
Three Witnesses									
3, 0	5.29%	38.88%	76.22%	92.35%	97.60%	99.28%	99.81%	99.96%	99.99%
2, 1	1.01%	10.42%	36.94%	68.80%	88.16%	96.17%	98.95%	99.79%	99.98%
1, 2	0.19%	2.08%	9.67%	28.73%	57.64%	82.12%	94.53%	98.87%	99.89%
0, 3	0.03%	0.39%	1.92%	6.86%	19.92%	45.63%	75.96%	94.09%	99.45%
Four Witnesses									
4, 0	2.09%	35.37%	82.54%	96.51%	99.29%	99.86%	99.98%	100%	100%
3, 1	0.39%	9.09%	46.35%	83.49%	96.24%	99.23%	99.87%	99.99%	100%
2, 2	0.07%	1.80%	13.64%	48.04%	82.40%	95.95%	99.28%	99.92%	100%
1, 3	0.01%	0.33%	2.81%	14.46%	46.11%	81.24%	96.21%	99.55%	99.98%
0, 4	0.00%	0.06%	0.52%	3.00%	13.52%	44.19%	82.26%	97.56%	99.90%
Five Witnesses									
5, 0	0.81%	32.00%	87.45%	98.45%	99.79%	99.97%	100%	100%	100%
4, 1	0.15%	7.92%	56.02%	92.06%	98.88%	99.85%	99.98%	100%	100%
3, 2	0.03%	1.55%	18.88%	67.95%	94.15%	99.19%	99.91%	99.99%	100%
2, 3	0.00%	0.29%	4.08%	27.93%	74.64%	95.72%	99.51%	99.97%	100%
1, 4	0.00%	0.05%	0.77%	6.62%	34.98%	80.34%	97.38%	99.82%	100%
0, 5	0.00%	0.01%	0.14%	1.28%	8.95%	42.75%	87.18%	99.02%	99.98%
Six Witnesses									
6, 0	0.31%	28.81%	91.13%	99.32%	99.94%	100%	100%	100%	100%
5, 1	0.06%	6.89%	65.25%	96.38%	99.67%	99.97%	100%	100%	100%
4, 2	0.01%	1.33%	25.55%	82.95%	98.23%	99.84%	99.99%	100%	100%

3, 3	0.00%	0.25%	5.90%	47.06%	91.01%	99.14%	99.94%	100%	100%
2, 4	0.00%	0.05%	1.13%	13.98%	64.92%	95.47%	99.67%	99.99%	100%
1, 5	0.00%	0.01%	0.21%	2.88%	25.28%	79.40%	98.20%	99.93%	100%
0, 6	0.00%	0.00%	0.04%	0.54%	5.82%	41.33%	90.89%	99.61%	100%
Seven Witnesses								
7, 0	0.12%	25.82%	93.81%	99.70%	99.98%	100%	100%	100%	100%
6, 1	0.02%	5.98%	73.47%	98.39%	99.90%	99.99%	100%	100%	100%
5, 2	0.00%	1.15%	33.60%	91.77%	99.48%	99.97%	100%	100%	100%
4, 3	0.00%	0.21%	8.47%	67.09%	97.21%	99.83%	99.99%	100%	100%
3, 4	0.00%	0.04%	1.66%	27.15%	86.43%	99.09%	99.96%	100%	100%
2, 5	0.00%	0.01%	0.31%	6.38%	53.79%	95.21%	99.77%	100%	100%
1, 6	0.00%	0.00%	0.06%	1.23%	17.54%	78.43%	98.77%	99.97%	100%
0, 7	0.00%	0.00%	0.01%	0.23%	3.74%	39.92%	93.61%	99.84%	100%
Eight Witnesses								
8, 0	0.05%	23.04%	95.71%	99.87%	100%	100%	100%	100%	100%
7, 1	0.01%	5.19%	80.32%	99.29%	99.97%	100%	100%	100%	100%
6, 2	0.00%	0.99%	42.73%	96.24%	99.85%	99.99%	100%	100%	100%
5, 3	0.00%	0.18%	12.00%	82.38%	99.17%	99.97%	100%	100%	100%
4, 4	0.00%	0.03%	2.43%	46.08%	95.63%	99.82%	100%	100%	100%
3, 5	0.00%	0.01%	0.45%	13.51%	80.02%	99.04%	99.97%	100%	100%
2, 6	0.00%	0.00%	0.08%	2.78%	42.26%	94.94%	99.85%	100%	100%
1, 7	0.00%	0.00%	0.02%	0.52%	11.80%	77.42%	99.16%	99.99%	100%
0, 8	0.00%	0.00%	0.00%	0.10%	2.39%	38.53%	95.55%	99.94%	100%
Nine Witnesses								
9, 0	0.02%	20.48%	97.05%	99.94%	100%	100%	100%	100%	100%
8, 1	0.00%	4.50%	85.75%	99.69%	99.99%	100%	100%	100%	100%
7, 2	0.00%	0.85%	52.39%	98.32%	99.96%	100%	100%	100%	100%
6, 3	0.00%	0.16%	16.74%	91.47%	99.76%	99.99%	100%	100%	100%
5, 4	0.00%	0.03%	3.55%	66.22%	98.69%	99.97%	100%	100%	100%
4, 5	0.00%	0.01%	0.67%	26.38%	93.23%	99.81%	100%	100%	100%
3, 6	0.00%	0.00%	0.12%	6.15%	71.58%	98.98%	99.98%	100%	100%
2, 7	0.00%	0.00%	0.02%	1.18%	31.52%	94.65%	99.89%	100%	100%
1, 8	0.00%	0.00%	0.00%	0.22%	7.76%	76.38%	99.42%	100%	100%
0, 9	0.00%	0.00%	0.00%	0.04%	1.51%	37.15%	96.93%	99.98%	100%
Ten Witnesses								
10, 0	0.01%	18.13%	97.98%	99.98%	100%	100%	100%	100%	100%
9, 1	0.00%	3.89%	89.87%	99.86%	100%	100%	100%	100%	100%

8, 2	0.00%	0.73%	61.86%	99.26%	99.99%	100%	100%	100%	100%
7, 3	0.00%	0.14%	22.87%	96.09%	99.93%	100%	100%	100%	100%
6, 4	0.00%	0.02%	5.14%	81.81%	99.62%	99.99%	100%	100%	100%
5, 5	0.00%	0.00%	0.98%	45.11%	97.93%	99.96%	100%	100%	100%
4, 6	0.00%	0.00%	0.18%	13.06%	89.65%	99.80%	100%	100%	100%
3, 7	0.00%	0.00%	0.03%	2.67%	61.29%	98.92%	99.99%	100%	100%
2, 8	0.00%	0.00%	0.01%	0.50%	22.45%	94.35%	99.93%	100%	100%
1, 9	0.00%	0.00%	0.00%	0.09%	5.02%	75.31%	99.61%	100%	100%
0, 10	0.00%	0.00%	0.00%	0.02%	0.96%	35.80%	97.88%	99.99%	100%